

## Ongoing and Upcoming Mission Highlights

### THE ESA HERA MISSION: DETAILED INVESTIGATION OF THE NASA DART IMPACT OUTCOME AND CHARACTERIZATION OF THE BINARY ASTEROID DIDYMOS

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## ABSTRACT

The Hera mission is in development in the Space Safety Program of the European Space Agency (ESA) in collaboration with JAXA for launch in October 2024 [1]. It will rendezvous with the binary asteroid (65803) Didymos in early 2027 and over the following 6 months will investigate the properties of Didymos and its small moon Dirmorphos, including the effects of the successful impact of the NASA DART probe [2].

DART was launched on 24 November 2021 at 06:21 UTC and successfully impacted at about 6.1 km/s on the 160 meter-size Dimorphos on 26 September 2022 at 23:14 UTC. Two weeks before impact, it deployed the Light Italian Cubesat for Imaging of Asteroids (LICIACube) that provided images during the few minutes following the impact. A campaign of observations from Earth and space provided distant images of the event, which were used to determine a reduction of 33 min in the orbital period of Dimorphos around Didymos.

The Hera mission will investigate the outcome of the DART impact in detail. In particular, it will determine the effects of the impact on Dimorphos' surface, e.g., whether it produced a crater, and if so its properties, and/or whether it led to global reshaping of Dimorphos. It will accurately measure the mass of Dimorphos, which will allow quantification of the momentum enhancement factor, which is a crucial parameter to evaluate the efficiency of the kinetic impactor technique. Hera will also determine in detail the physical, thermal and compositional properties of the asteroid, including first time measurements of the internal properties, which have a critical influence on the impact outcome. With Hera and DART together, we will have a fully documented deflection test and impact experiment that will allow us to verify our numerical impact models, to be able to extrapolate this deflection test to other asteroids and to improve our understanding of the complex geological properties and response of small asteroids.

Hera consists of a mother spacecraft and two cubesats. It will perform the first rendezvous with a binary asteroid, arriving at Didymos about 4 years after DART. Hera will not only contribute significantly to the planetary defense effort by documenting entirely the outcome of the DART impact, it will also greatly advance our understanding of processes in the very low gravity regime of a small asteroid (Dimorphos) as well as our knowledge of binary asteroids and asteroid geophysics. The mission development is progressing nominally, with the Critical Design Review having been passed in Nov. 2022. The various working groups of the Hera Science Team are working intensively to support this development and be best prepared for the surprises that Hera will offer during its visit to Didymos in 2027.

## References

- [1] Michel P. et al. 2022. Planetary Science Journal 3:160.
- [2] Rivkin A. et al. 2021. Planetary Science Journal 2: 173.

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